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TWO NEW SPECIES OF THE SCORPIONFISH GENUS *RHINOPIAS*, WITH COMMENTS ON RELATED GENERA AND SPECIES

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Abstract. A new scorpionfish, *Rhinopias argoliba*, is described from Japan. A new species name, *Rhinopias aphanes*, is given for a specimen identified as *R. frondosa* (Günther) by Whitley (1964), and this single known specimen from New Caledonia is described and figured. Additional specimens of *Rhinopias xenops* (Gilbert) and *Rhinopias frondosa* are described. *Rhinopias godfreyi* Whitley is referred to the genus *Pteroidichthys*. The genus *Pteroidichthys* Bleeker is thought to be closely related to *Rhinopias* Gill. The monotypic genus *Pogonoscorpius* Regan, known only from the holotype of *P. sechellensis* Regan, possibly is a synonym of the genus *Rhinopias*. Remarks are given on the monotypic genera *Hipposcorpaena* and *Pteropelor*, both described by Fowler (1938) from juvenile specimens. Comments on shedding of 'skin' in these and other scorpaenid fishes are given.

Introduction

Specimens of the genus *Rhinopias* are very rare and are among the most striking of fishes in coloration and form. Species are known from the Indian

Ocean and the central and western Pacific Ocean. The two new species described here bring to four the number of species in the genus. The few specimens known previously have received considerable attention (Palmer, 1963; Smith, 1966; and others). We include with the descriptions of the new species information on the other two species, including new records, and offer comments on related genera and species.

The Japanese specimen on which one new species description is based already has had an interesting history. It was collected by Mr. Hajime Masuda and maintained alive in the Enoshima Aquarium, Fujisawa, Japan. This specimen was depicted in color on the cover of *Fish Magazine* (1971) and it was the subject of articles on shedding of skin by one of us (Hirosaki, 1971a–c). The second new species is based on a specimen which was first displayed in the Nouméa Aquarium in New Caledonia and was figured by Whitley (1964) as *Rhinopias frondosa* (Günther).

Shedding of 'skin' in scorpaenid fishes has received some attention, most recently by Hirosaki (1971a–c) and Wickler and Nowak (1969). Information is provided on additional genera of scorpaenid fishes observed to shed.

Acknowledgments

We wish to express our sincere thanks to Mr. Hajime Masuda, Izu Ocean Park, Itō City, Japan, for his generosity and thoughtfulness. He provided the first and only known specimen of *Rhinopias argoliba*, allowing it first to be displayed alive in the Enoshima Aquarium, and second to be studied by us. We gratefully acknowledge the valuable services rendered by Dr. Chūichi Araga, Seto Marine Biological Laboratory (SMBL), Kyoto University, and Dr. Osamu Okamura, Kōchi University (KU); they provided information and sent on loan Japanese specimens and color slides. Similarly, we are grateful to Mr. Paul J. Struhsaker, National Marine Fisheries Service, Honolulu, Hawaii, for providing an unreported specimen of *Rhinopias xenops* from Hawaii and two specimens of *R. frondosa* from the Caroline Islands. We are grateful to Dr. R. Catala, Nouméa Aquarium, New Caledonia, for providing a color slide, photographs, and additional information on the holotype of *R. aphanes*.

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M. L. Bauchot, Jørgen Nielson, and John R. Paxton loaned specimens. Alwyne Wheeler provided additional information for some specimens. Richard Krejsa, California State Polytechnic College, analyzed shed 'skin' from scorpionfishes for us. Pearl Sonoda, Tomio Iwamoto, Maury Giles, Kathy Smith, Kathryn Boyer, and other staff members of the California Academy of Sciences (CAS) aided the study.

We wish to thank Lillian J. Dempster, CAS, for her help with literature, for her comments on the manuscript, and for assisting in the selection of new species names. K. V. Rama Rao provided comments on the manuscript.

Methods

Methods of measuring and counting follow Eschmeyer (1969); exceptions to measurements commonly used to describe teleosts include the following: pectoral-fin length is measured from the base of the first ray to the end of the longest ray with the fin pointing back; measurements originating from the anterior end of the fish are taken from the most anterior point of the left premaxillary, and measurements are made on the left side of specimens. The last soft ray of the dorsal fin and anal fin is a double ray and the expression XII + 9½ is used to signify 12 spines and 9 soft rays (last double). Terminology of head spines follows Matsubara (1943) and Eschmeyer (1969). Abbreviations for depositories of specimens are given in the Acknowledgments section except for the following: EA—Enoshima Aquarium, Fujisawa.

Genus **Rhinopias** Gill

Rhinopias Gill, 1905, p. 225 (type-species *Scorpaena frondosa* Günther, 1891, by original designation; monotypic).

Peloropsis Gilbert, 1905, p. 630 (type-species *Peloropsis xenops* Gilbert, 1905, by original designation; monotypic).

Remarks. The genus *Rhinopias* has about six months priority over the genus *Peloropsis*. The monotypic genus *Pogonoscorpius* Regan (1908), with the type-species *P. sechellensis*, may also be a synonym of *Rhinopias*. *Pogonoscorpius sechellensis* is still known only from the holotype (see our treatment of *Pogonoscorpius*). *Rhinopias godfreyi* Whitley (1954) is referred to the genus *Pteroidichthys* Bleeker.

Diagnosis. Dorsal fin XII + 9½; anal fin III + 5½; pectoral rays 15–18, some rays branched in larger specimens; scales on body small and cycloid, over 60 vertical scale rows; head unscaled; vomerine teeth present; palatine teeth absent; vertebrae 24; body compressed; second suborbital bone becoming wider posteriorly, attached to preopercle; third suborbital bone absent; no slit behind fourth gill arch.

Spination. Head spination is similar for all species. Most spines poorly developed. Nasal spines small, usually absent in one species. Preocular, supra-

ocular, and postocular spines present; sometimes preocular and supraocular spines reduced; supraocular spine obscured by tentacle; postocular spine as broad shelf above rear of orbit. Parietal and nuchal spines well developed, joined. Sphenotic spine (as group of small spines) absent in some species. Pterotic spine well developed. Upper posttemporal spine small; lower posttemporal spine well developed. Supracleithral and cleithral spines rounded. Opercular spines blunt at tips. Tympanic, coronal, and interorbital spines absent. Supplemental preopercular spine present or absent. First three preopercular spines moderate, fourth small, fifth absent or barely perceptible. Suborbital ridge with four low spines or lumps, first on lateral face of preorbital bone, followed by one under front of eye, and two just before preopercular bone; sometimes these spines may be absent or poorly developed. Preorbital bone with 2 poorly defined spines over maxillary (second and third preorbital lobes of Matsubara, 1943).

Key to the Species of the Genus *Rhinopias*

1. Pectoral rays 18 [17 and 19 should be expected]; no black spot or ocellus on soft dorsal fin 2
1. Pectoral rays 16 or 15 [17 should be expected]; black spot or ocellus present on soft dorsal fin 3
2. Skin flaps absent on lower jaw; few skin flaps on body; third dorsal spine about 3 times in head length and about two-thirds of snout ..... *Rhinopias argoliba* (figs. 1–2A)
2. Skin flaps present on lower jaw; head, body, and fins with numerous skin flaps; third dorsal spine about two times in length of head or less than 2 times if third spine is especially elongate, third spine longer than snout ..... *Rhinopias xenops* (figs. 2B, 3–4)
3. Body, head, and fins with round and oblong pale (dark rimmed) spots or blotches; sometimes almost entirely pallid in preservative ..... *Rhinopias frondosa* (figs. 5–7)
3. Body, head, and fins with dark reticulations on a paler background ..... *Rhinopias aphanes* (fig. 8)

Species Accounts

Rhinopias argoliba Eschmeyer, Hirosaki, and Abe, new species.

(Figures 1–2A.)

No scientific name used, Hirosaki, 1971a, pp. 4–5, 2 figs. (shedding); 1971b, pp. 26–27, front cover, 5 figs. (shedding; cover in color showing live coloration); 1971c, p. 170, fig. (shedding).

Inimicus didactylum (not of Pallus), Axelrod and Burgess, 1972, figs. 466, 470 (misidentification; poor color reproduction of specimen when alive in the Enoshima Aquarium).

Holotype. Enoshima Aquarium no. 1 (129 mm. S.L., 167 mm. T.L.), Japan, Sagami Bay, caught off Izu Ocean Park, Itō City, at a depth of 50 meters, 15 January 1971 [transferred alive to Enoshima Aquarium on 30 January 1971, where it died on 23 May 1971].

Description. (Based on the holotype and only known specimen.) A large-headed, compressed scorpionfish. Dorsal fin with 12 spines and 9½ soft rays;

Figure 1. *Rhinopias argoliba*, holotype, EA no. 1, 129 mm. S.L., Japan; note white coloration below eye and above pectoral fin (from the specimen when alive).

third dorsal spine not elongate, fourth spine the longest, eleventh dorsal spine about ¾ the length of the twelfth spine. Anal fin with 3 spines and 5½ soft rays; first spine slightly more than one-half length of second, third spine longest. Pectoral rays 18, only one or two branched rays in each fin (branching of pectoral rays variable with size in other species). Gill rakers (including rudiments) total 23, 7 on upper arch, 16 on lower arch including one at angle, all rakers as short spiny knobs. Scales on body small and cycloid; about 80 vertical scale rows (count made a few scale rows above lateral line from above first lateral-line scale to end of hypural plate). Head without scales.

Spination similar to that of other species of *Rhinopias* (see account under genus). Nasal spines small. Supplemental preopercular spine present, small, lying above first preopercular spine. Sphenotic spines absent in available specimen. Suborbital ridge with 4 spines; first a sharp one on preorbital bone, followed by one under the eye and two lumps before the preopercular bone.

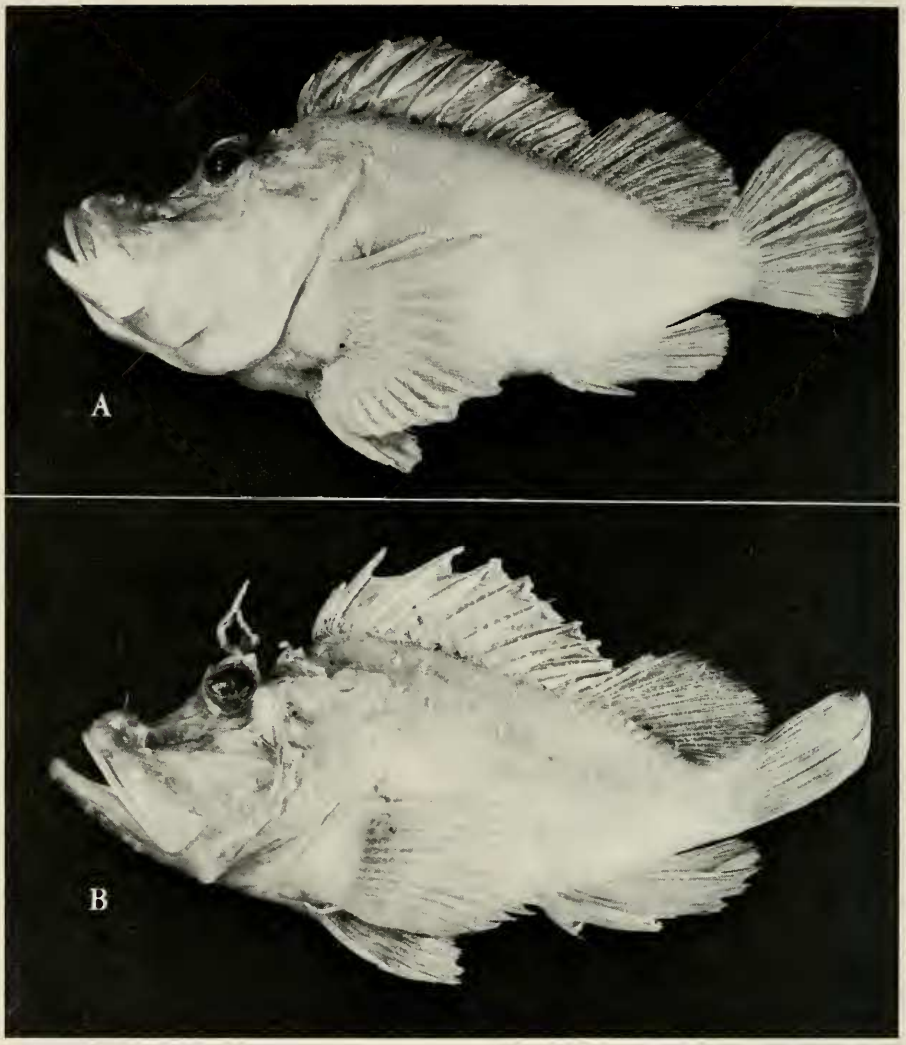

FIGURE 2. A. *Rhinopias argoliba*, holotype, EA no. 1, 129 mm. S.L., Japan. B. *Rhinopias xenops*, USNM 209415, 107 mm. S.L., Hawaii.

Measurements for the holotype in table 1.

Tentacles on body few. No supraocular tentacle in available specimen; no skin flaps on lower jaw as in other species; small skin flaps on nostrils, on eye, on lower margin of preopercle, on some lateral-line scales, and a few very tiny ones on the pectoral fin. (The development of tentacles and skin flaps is somewhat variable in scorpaenid fishes. See the 'Comparisons and Remarks' section below.)

Coloration in preservative almost entirely pallid (fig. 2); no reticulations present, no dark spot on soft dorsal fin. White stripe before eye slightly visible; some faint dark areas below eye (melanophores contracted). Color in life bright red, including all of body, head, and fins, with the exception of the white stripe before the eye, white patches near base of lower pectoral rays, a few scattered white spots on body and snout, one conspicuous spot about size of pupil just above lateral line over pectoral fin, and another spot on dorsal part of caudal peduncle. About 15–20 small (0.2–0.5 mm. in diameter) dark blue specks on head, most concentrated below eyes just above suborbital ridge. Spinous dorsal fin tipped with white. The white stripe (fig. 1) before the eye expanded into a circular spot at distal end (resembling an exclamation point [!]), 'spot' separated from stripe on left side, partially joined to stripe on right side (see Hirosaki, 1971c, fig. on p. 170, or Axelrod and Burgess, 1972, figs. 466, 470).

Comparisons and Remarks. This species is easily distinguished from *R. frondosa* and *R. aphanes* by having a higher pectoral fin ray count (18 versus 16 or 15). The development of tentacles and skin flaps on the head and body is variable but presence on the lower jaw is a stable feature in species of other genera. Of the four species of *Rhinopias* only *R. argoliba* lacks tentacles on the lower jaw. *Rhinopias argoliba* appears to be closely related to *R. xenops* with which it shares a pectoral fin ray count of 18. The holotype of *R. xenops* has the third dorsal spine notably elongate, but the additional specimens from Hawaii and two Japanese specimens do not, although the third spine is slightly elongate in two. In some scorpionfishes which have one or more dorsal spines elongate, this elongation is variable and does not occur until the fish reaches the subadult stage or even the adult stage; we do not know if this difference will be useful for distinguishing large specimens. The dorsal spines are proportionally shorter in the specimens of *R. argoliba* than in *R. xenops*. The second anal spine is shorter than the third in *R. argoliba*, but about equal in length to the third in *R. xenops*. Most fin spines are proportionately shorter in *R. argoliba* than in *R. xenops*. The pectoral fin in *R. argoliba* is shorter than in *R. xenops*. The holotype of *R. argoliba* is as large or larger than the known specimens of *R. xenops* but has fewer branched pectoral rays (2 or 3 versus 5 to 7). Branching of pectoral rays in scorpaenids begins in juveniles and increases with increase in size to a maximum number of branched rays. The dentition on the premaxillaries is stronger in *R. xenops* than in *R. argoliba*. Differences in coloration of *R. argoliba* and *R. xenops* may be useful in distinguishing these species. The entire specimen of *R. argoliba* was bright red in life, including the head, body, and fins, with the exception of milky white spots on the body and the white stripe before the eye as given in the description above. The coloration in *R. xenops* is quite different (see account of *R. xenops*).

We do not know what affect, if any, the 114-day stay in the Enoshima Aquar-

ium had on the growth of the holotype of *R. argoliba* as might be reflected in unnatural lengths of some body parts. The only damage to the specimen seems to be that a callus formed at the symphysis of the lower jaw, caused by friction against glass.

Distribution. Known only from the holotype collected from Japan, off Itō, Sagami Bay, at a depth of 50 meters.

Name. The scientific name '*argoliba*' (treated as an adjective) is from Greek, *argos* (white) plus *libos* (tear or drop), alluding to the milky-white teardrop below the eye. The Japanese common name Namida-kasago is proposed and is based on "namida," or tear, plus "kasago," the Japanese name for *Sebastiscus marmoratus*.

Rhinopias xenops (Gilbert).

(Figures 2B, 3–4.)

Peloropsis xenops Gilbert, 1905, pp. 630–631, text fig. 245 (original description; type locality Hawaii, Auau Channel, between Maui and Lanai Islands, depth 32 to 43 fathoms, *Albatross* station 3872, 12 April 1902; holotype USNM 51604); Jordan and Seale, 1906, p. 379 (listed; Hawaii); Jordan and Evermann, 1926, p. 10 (listed; Hawaii); Fowler, 1928, p. 287 (compiled description); 1938, p. 290 (listed; Hawaii); Tinker, 1944, pp. 262–264, fig. (compiled; figure from Gilbert, 1905); Gosline and Brock, 1960, pp. 284, 286, 341 (in key; compiled); Palmer, 1963, pp. 701–704, pl. XX (in part; wrongly included Japanese specimens [Kamohara, 1942, *et seq.*]; compared with *R. frondosa*); Gosline, 1965, p. 825 (depth distribution; compiled).

Rhinopias xenops, Whitley, 1954, p. 61 (placed in genus *Rhinopias*; distinguished from other species); Smith, 1966, pp. 74, 77–79 (in key, distinguished from *R. frondosa*).

Peloropsis frondosus, Kamohara, 1959, pp. 5–6 (in part; *R. xenops* in synonymy; thought *R. xenops* may be variant of *R. frondosus* rather than a distinct species).

Material. USNM no. 51604 (1, 110 mm. S.L., holotype), Hawaii, Auau Channel, between Maui and Lanai Islands, depth 32 to 43 fathoms, *Albatross* station 3872, 12 April 1902. USNM no. 209415 (1, 107 mm. S.L.), Hawaii, Haleiwa, 21°39.6′ to 21°42′N., 158°07.3′ to 158°05′W., 41-ft. shrimp trawl, in 95–110 meters, *Townsend Cromwell* cruise 36, station 19, 3 May 1968. SMBL no. 7201 (1, 114 mm. S.L.), Japan, off Shirahama Town, Nishimuro County, Wakayama Prefecture, rocky bottom, 31 October 1971. SMBL no. 7202 (1, 129 mm. S.L.), Japan, off Nambu Town, Hidaka County, Wakayama Prefecture, bottom gill net on rocky substrate, 31 January 1969.

Distinguishing features. Preserved specimens mostly pallid; pectoral fin rays 18; no ocellus or dark spot on soft dorsal fin; vertical scale rows about 70; skin flaps present on lower jaw.

Remarks. The specimens reported here agree with the holotype in most features. The third dorsal spine is elongate in the holotype (fig. 3) but it is not especially elongate in the other specimens (figs. 2B, 4). The specimens agree in counts. All have 18 pectoral rays, rays 2–7 branched in the holotype (also

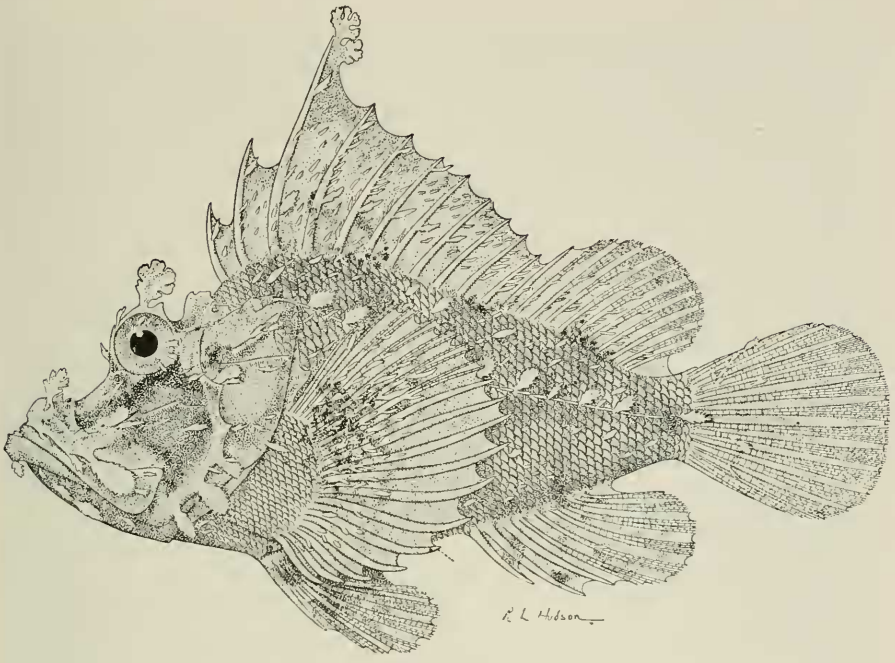

Figure 3. *Rhinopias xenops*, holotype, USNM no. 51604, 110 mm. S.L., Hawaii.

the 9th on left side in the holotype), rays 1–7 or 2 through 6 or 7 branched in the other specimens. Gill rakers (including rudiments) total 21 to 23, 6(7) on upper arch, 15–17 on lower arch. Vertical scale rows number about 70–75, and lateral line scales 22 or 23. Head spination as for the genus. Nasal spines small. Supplemental preopercular spine present, small. Sphenotic spines absent or small.

An extensive color description was given by Gilbert (1905, p. 631) as follows:

> "Head, body, and fins bright vermilion, upper parts of head and body darkened with olive tint, and with small scattered purplish spots, which are also found on upper half of pectoral fin; head, lower parts of body, and fins mottled with yellowish-white; flaps and tentacles narrowly edged with bright lemon-yellow; a large blackish blotch below eye, one on opercle and one at base of pectoral; a conspicuous broad, yellowish white bar on each side of compressed part of rostrum; three groups of brownish spots along base of dorsal fins; conspicuous white spots on back of tail and at base of eighth and ninth dorsal spines; a larger blotch below the latter just above lateral line."

No information on fresh coloration is available for the additional specimen from Hawaii. A Kodachrome slide of a Japanese specimen (SMBL 7202) revealed the following: body and head mostly orange-red; small purplish specks on upper part of head and body; large patch of white on body below dorsal spines

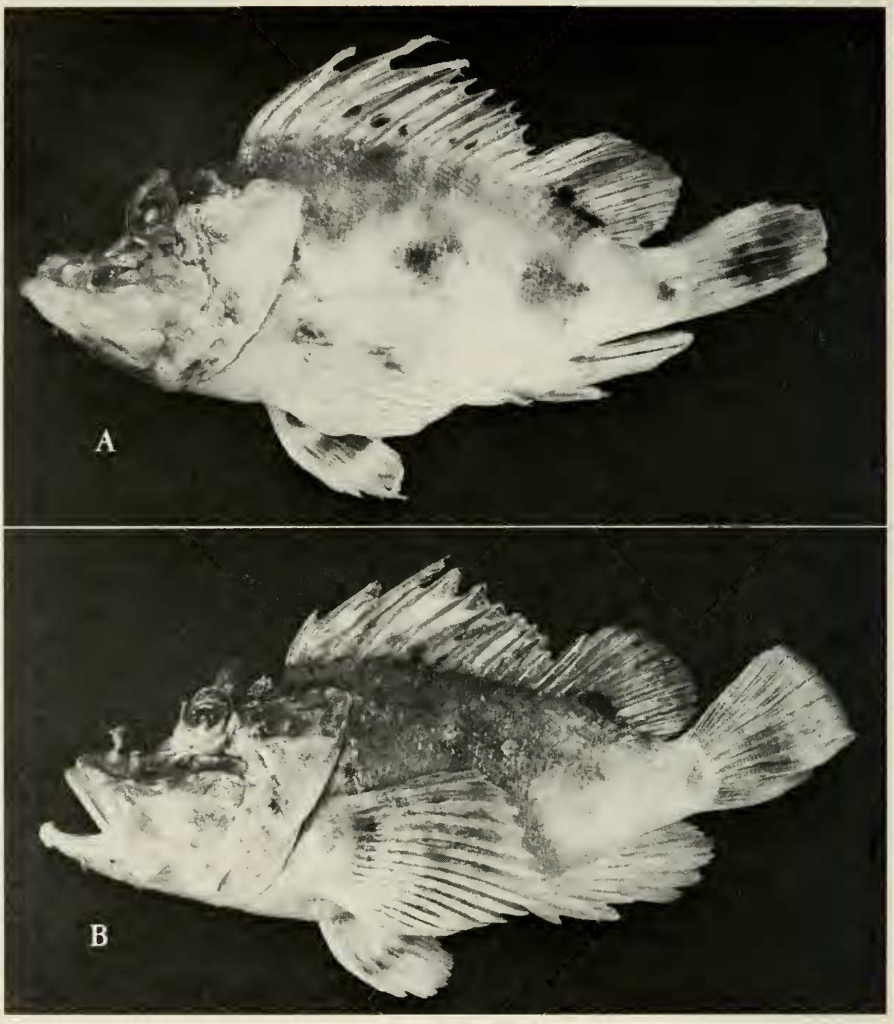

FIGURE 4. *Rhinopias xenops*. A. SMBL no. 7201, 114 mm. S.L., Japan. B. SMBL no. 7202, 129 mm. S.L., Japan.

7–10, with a smaller white spot just above lateral line below this large white patch; other white patches on head, pectoral fin, and scattered on body; small, tapering pale stripe leading forward and down from eye. The coloration of the Japanese specimen is similar to that given by Gilbert for the holotype with a few exceptions. The Japanese specimen had more orange and less red pigment on the head and body and lacked most of the lemon-yellow pigmentation as found by Gilbert. Some differences may result from occurrence at different

depths; the Japanese specimen was on display in an aquarium when photographed while Gilbert's description was taken from the holotype recovered from 32–43 fathoms. Dusky patches were similar as evidenced by the preserved condition. The major features of the distribution of white patches were very similar.

Coloration in preservative (figs. 2B, 3–4) for all specimens is basically similar, the most conspicuous feature being the dusky pigment at the base of the soft dorsal fin.

Measurements are given in table 1.

Distribution. *Rhinopias xenops* is now known from Hawaii and Japan. Previous records of this species from Japan were based on specimens of *R. frondosa*. Depths of capture for the Hawaiian specimens were between 32 and 43 fathoms and between 52 and 60 fathoms. Depths of capture for the Japanese specimens are not available, but they were captured offshore. Habitat appears to be rocky or coralline areas.

Name. 'Nise-boro-kasago' is proposed as the Japanese common name, from 'nise' (pseudo) + 'boro' (ragged or tattered) + 'kasago' (*Sebastiscus marmoratus* or similar fish). Boro-kasago is the Japanese name for *Rhinopias frondosa*.

Rhinopias frondosa (Günther).

(Figures 5–7.)

Scorpaena frondosa Günther, 1891, pp. 482–483, pl. XXXIX (original description; type locality Mauritius; holotype BMNH 1891.4.30.3).

Peloropsis xenops (not of Gilbert), Kamohara, 1942, pp. 27–28, fig. 1 (description; differences between his specimens and the holotype of *R. xenops*; two specimens from Shirahama, Wakayama Prefecture, Japan); 1950, p. 219, fig. 165 (compiled; figure from Kamohara, 1942).

Peloropsis frondosa, Deraniyagala, 1952, p. 109, pl. 32 (specimen from Ceylon; figure poor; lengths and body proportions incorrect [see Smith, 1966, p. 77]).

Peloropsis frondosus, Munro, 1955, p. 250, pl. 48, fig. 726 (compiled; figure copied from Deraniyagala, 1952); Kamohara, 1959, pp. 5–6, fig. 2 (description; one specimen from Susaki Fish Market; figure from Kamohara, 1942); 1964, pp. 73–74, fig. 47 (listed; Kochi Prefecture, Japan; figure from Kamohara, 1942); Fourmanoir and Nhu-nhung, 1965, p. 93, fig. 59 (two specimens from Viet Nam; line drawing); Fourmanoir and Guézé, 1966, pp. 56–57, fig. III d (Reunion Island, 90 m.)

Rhinopias frondosa, Smith, 1957, p. 62, pl. 4, fig. C (compiled; copied from Günther); Palmer, 1963, pp. 701–704, pl. XX (summary of earlier records of *Rhinopias*; treated *R. xenops* and *R. frondosa* as separate species; radiographs of *R. xenops* and *R. frondosa*); Kotthaus, 1966, p. 122 (figure of a specimen from the northern Indian Ocean); Smith, 1966, pp. 74–79, fig. B on pl. 14 (synonymy; description; new record for South African waters; summary of earlier knowledge on *R. xenops* and *R. frondosa* and differences between them; retouched photo of a 45 mm. S.L. specimen).

Material. BMNH no. 1891.4.30.3 (1, 146 mm. S.L., holotype), Mauritius, collected by Robillard. MNHN 1967–550 (1, 79.5 mm. S.L.), Reunion Island. BAH uncat. (1, 145 mm. S.L.), off Somalia, 6°06′ to 6°03′N., 49°05′ to 49°03′E.,

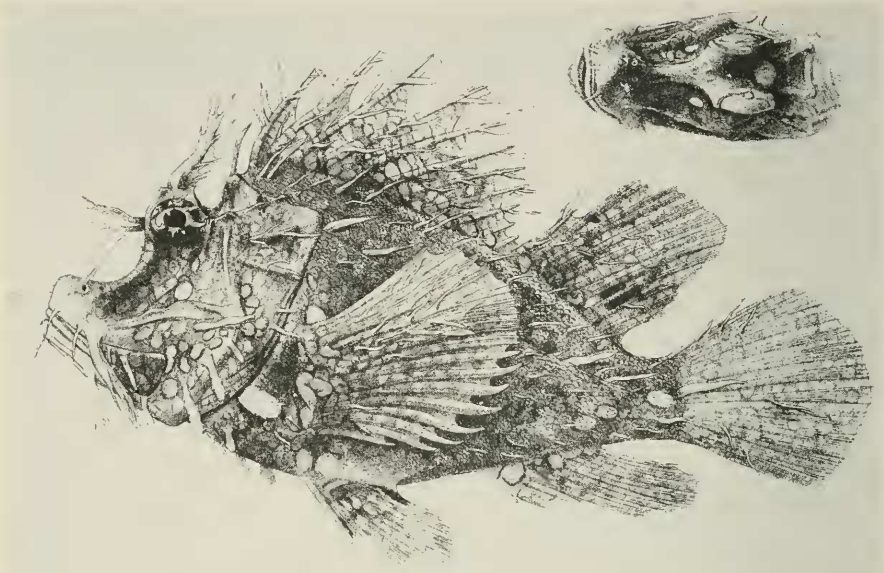

Figure 5. *Rhinopias frondosa*, holotype, BMNH no. 1891.4.30.3, 146 mm. S.L., Mauritius (from Günther, 1891, pl. 39).

in 55–65 meters, *Meteor* station 123. KU no. 8465 (1, 152 mm. S.L.), Japan, Kochi Prefecture, Susaki Fish Market, 12 March 1959. SMBL no. 7203 (1, 127 mm. S.L.), Japan, Nambu Town, Hidaka County, Wakayama Prefecture, gill-net on rocky bottom, 17 January 1959. SMBL no. 7204 (1, 146 mm. S.L.), Japan, off Iwashiro, Hidaka County, Wakayama Prefecture, lobster gill-net on rocky bottom, 18 April 1959. USNM no. 209416 (1, 103 mm. S.L.) and CAS no. 15320 (1, 115 mm. S. L.), Caroline Islands, Condor Reef, in 30 fathoms, 12.5-m. shrimp trawl, *Townsend Cromwell* Cruise 57, 24 May 1972.

Distinguishing features. Pectoral rays 16 (rarely 15, but 17 rays would not be unusual); dark spot on membrane of soft dorsal fin between rays 7–9, sometimes more restricted; body and fins of preserved specimens covered with large brown circles or with pale spots or oblong blotches on light brown background, vertical scale rows about 70–75; skin flaps present on lower jaw.

Remarks. The known specimens up until now of this species have been reviewed in two articles (Palmer, 1963; Smith, 1966). Both authors reached the conclusion that *R. frondosa* is distinct from *R. xenops*. The color patterns of all the known preserved specimens of *R. frondosa* are similar except for one from Nouméa reported on by Whitley (1964, p. 9, pl. II). The Nouméa specimen is felt by us to represent a separate species and is treated as a new species, *R. aphanes*, in a separate section of this paper.

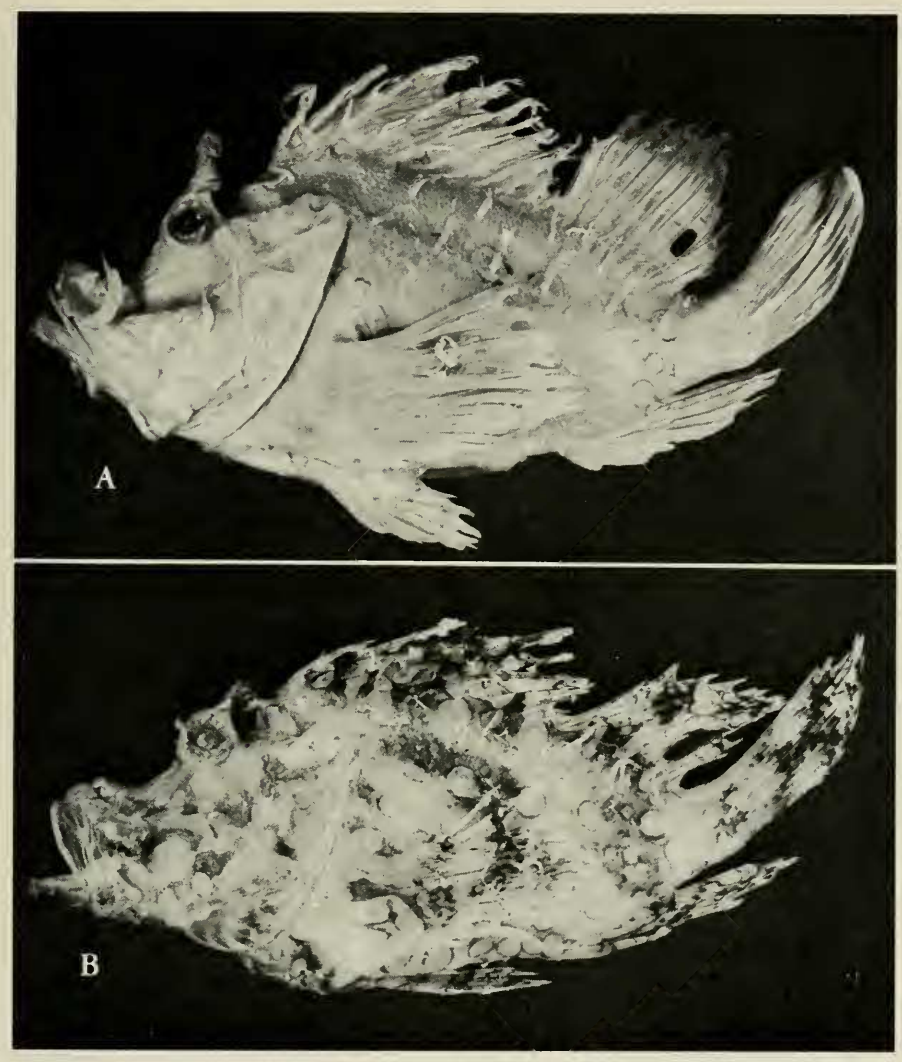

FIGURE 6. *Rhinopias frondosa*. A. KU no. 8465, 152 mm. S.L., Japan. B. MNHN no. 1967–550, 79.5 mm. S.L., Reunion Island.

Measurements and counts are presented in table 1. The holotype, specimens from Japan, Reunion Island, and the Caroline Islands are figured (figs. 5–7).

Color slides provided by Dr. Araga of 2 Japanese aquarium specimens (both about 230 mm. T.L.) revealed the following: specimen 1 with body, head, and fins reddish pink (approaching maroon): all of specimen covered with mostly

Table 1. *Counts and measurements for specimens of the genus* Rhinopias. *(Measurements are in mm.; percent standard length in parentheses; see Materials Examined for catalog numbers and locality information; holotype marked with an asterisk.)*

	R. argoliba	*R. xenops*				*R. aphanes*	*R. frondosa*
Standard length	129*	107	110*	114	129	178*	79.5
Dorsal rays	XII+9½	XII+9½	XII+9½	XII+9½	XII+9½	XII+9½	XII+9½
Anal rays	III+5½	III+5½	III+5½	III+5½	III+5½	III+5½	III+5½
Pectoral rays	18+18	18+18	18+18	18+18	18+18	16+16	16+16
Gill rakers	7+16	6+15	6+16	6+17	6–7+16	6+14	?6+14
Vertebrae	24	24	24	24	24	24	24
Vertical scale rows (approximate)	80	70	68	76	73	70	—
Head length	59.5(46)	51.7(48)	51.2(46)	53.9(47)	60.1(47)	85.5(48)	36.8(46)
Body depth	55.2(43)	45.7(43)	48.7(44)	47.4(42)	53.3(41)	82.1(46)	35.0(44)
Orbit diameter	10.3(08)	9.5(09)	10.0(09)	10.0(09)	11.1(09)	13.5(07)	7.0(09)
Snout length	26.5(21)	21.1(20)	20.6(19)	22.2(19)	25.6(20)	40.0(22)	14.8(19)
Interorbital width	5.8(04)	4.4(04)	5.3(05)	4.5(04)	6.0(05)	10.5(06)	4.2(05)
Jaw length	29.5(23)	26.4(25)	26.4(24)	28.4(25)	31.2(24)	42.0(24)	16.9(21)
Predorsal-fin length	47.7(37)	40.7(38)	42.2(38)	45.6(40)	48.8(38)	74.1(42)	29.3(37)
Caudal fin length	32.6(25)	—	—	33.6(29)	38.6(30)	52.6(30)	30.5(38)
Pectoral fin length	37.5(29)	33.3(31)	39.9(36)	42.2(37)	45.6(35)	67.7(38)	30.3(38)
Pelvic fin length	29.2(23)	29.3(27)	33.6(30)	31.3(27)	33.2(26)	49.3(28)	23.9(30)
Length 1st anal spine	9.6(07)	11.6(11)	13.2(12)	10.6(09)	13.2(10)	16.1(09)	8.7(11)
Length 2nd anal spine	17.2(13)	22.0(21)	22.6(21)	23.0(20)	21.4(17)	23.5(13)	14.1(18)
Length 3rd anal spine	20.0(16)	21.4(20)	22.7(21)	21.7(19)	21.5(17)	25.1(14)	15.1(19)
Length 3rd dorsal spine	20.3(16)	25.2(24)	40.0(36)	34.7(30)	35.3(27)	41.7(23)	22.6(28)
Length 4th dorsal spine	21.2(16)	25.8(24)	31.2(27)	32.8(29)	30.9(24)	—	24.9(31)
Length 11th dorsal spine	11.7(09)	—	—	12.1(11)	11.7(09)	8.5(05)	6.3(08)
Length 12th dorsal spine	12.2(10)	—	—	16.3(14)	16.8(13)	21.9(12)	13.6(17)

circular white spots or blotches, but with central area of blotches or spots usually colored same as body; pigment around edges of these pale areas slightly darker than surrounding areas; some small pale blotches between larger circular areas. Specimen 2 with more pink on fins and tentacles, and with head and body more brownish red. Transparent, oblong areas between upper pectoral rays at about midheight of fin visible in specimen two. Kamohara (1959) reported that the body (our KU 8465, 152 mm. S.L.) was uniform reddish; head bluish, lower parts of body and fins mottled with white, and black blotch on membrane between seventh and eighth dorsal rays. Smith (1966, p. 77, pl. 14B) reported the coloration of his 45 mm. S.L. specimen as follows:

> "Colour in life. . .milky yellow, with orange tinge over the opercle. The body is covered with thin brown lines forming irregular loops of varying size and shape. The iridal flaps are almost black, giving a radial effect. There are a few prominent dark

TABLE 1 (*Continued*)

	R. frondosa (continued)						
Standard length	103	115	127	145	146*	146	152
Dorsal rays	XII+9½	XII+9½	XII+9½	XII+9½	XII+9½	XII+9½	XII+9½
Anal rays	III+5½	III+5½	III+5½	III+5½	III+5½	III+5½	III+5½
Pectoral rays	16+16	16+16	16+16	16+16	16+16	16+16	16+16
Gill rakers	6+15	6+15	7+15	—	6+15	6–7+15	6+14
Vertebrae	24	24	24	—	24	24	24
Vertical scale rows (approximate)	70–75	72	—	—	—	75	75
Head length	46.3(45)	57.1(50)	59.0(46)	65.3(45)	66.6(46)	68.0(46)	67.3(44)
Body depth	46.8(45)	59.6(52)	61.6(48)	66.3(46)	66.8(46)	69.8(48)	70.7(46)
Orbit diameter	8.2(08)	11.2(10)	10.3(08)	11.4(08)	12.4(08)	13.0(09)	12.0(08)
Snout length	20.5(20)	23.8(21)	26.6(21)	30.2(21)	29.9(20)	28.9(20)	29.1(19)
Interorbital width	6.3(06)	7.7(07)	8.3(06)	8.0(06)	8.6(06)	9.7(07)	8.3(06)
Jaw length	20.5(20)	26.0(23)	25.8(20)	30.1(21)	30.8(21)	30.7(21)	32.1(21)
Predorsal-fin length	37.6(36)	46.2(40)	47.8(38)	50.6(35)	58.0(40)	56.5(39)	56.4(37)
Caudal fin length	35.7(35)	43.7(38)	41.9(33)	48.0(33)	49.0(34)	47.4(32)	48.5(32)
Pectoral fin length	37.3(36)	48.4(42)	47.4(38)	49.5(34)	49.5(34)	53.9(37)	55.1(36)
Pelvic fin length	26.2(25)	32.3(28)	33.4(26)	39.2(27)	42.1(29)	40.3(28)	37.8(25)
Length 1st anal spine	8.4(08)	9.3(08)	8.8(07)	—	10.5(07)	11.2(08)	10.0(07)
Length 2nd anal spine	13.0(13)	15.5(14)	15.7(12)	—	19.0(13)	17.8(12)	17.9(12)
Length 3rd anal spine	16.3(16)	18.5(16)	17.1(13)	—	21.7(15)	20.9(14)	21.7(14)
Length 3rd dorsal spine	27.4(27)	39.7(34)	38.0(30)	—	45.7(32)	41.6(28)[1]	37.8(25)
Length 4th dorsal spine	27.5(27)	38.6(34)	33.0(26)	—	53.0(36)	47.7(33)	36.2(24)
Length 11th dorsal spine	5.3(05)	5.8(05)	6.2(05)	—	9.0(06)	9.7(07)	7.8(05)
Length 12th dorsal spine	13.6(13)	18.2(16)	17.1(14)	—	19.0(13)	24.4(17)	20.4(14)

[1] Broken at tip.

marks on the fins, one rectangular, low, between the 5–6th dorsal spines, one, smaller, behind the base of the ninth dorsal spine, one across the upper part of the second dorsal ray, a small one on the upper and another at the lower part of the caudal. The largest is low down between the seventh and eighth dorsal rays, and the smallest (but distinct) between the apices of the first and second (upper) rays of the pectoral fin."

Deraniyagala (1952, pl. 32) illustrates a 126-mm. T.L. specimen as mostly orange-red. The general body coloration appears to change from mostly yellow in small specimens to mostly red or crimson in large specimens. Our specimen from Reunion Island (fig. 6B) has the dark pigment most concentrated in the areas mentioned by Smith as prominent dark marks. The retention in preservative of the dark, mostly circular lines (outlining the pale areas) is variable (figs. 5–7) and seems to depend on the amount of black or brown pigment

FIGURE 7. *Rhinopias frondosa*, CAS 15320, 115 mm. S.L., Caroline Islands.

present initially and perhaps on the method of preservation. Kotthaus (1966, pl. 22) provides an excellent figure of a 145-mm. S.L. specimen.

Spination as for the genus. Nasal spines usually absent. Supplemental preopercular spine absent or poorly developed. Sphenotic spines present.

The reader is referred to the papers cited above for a detailed description of *R. frondosa*.

DISTRIBUTION. *Rhinopias frondosa* is known from Mauritius, Reunion Island, Natal, Somalia, the Arabian Sea, Ceylon, Vietnam, Japan, and the Caroline Islands. Few depths of capture are available: dredged in 13 meters in Ceylon (Deraniyagala, 1952); in 55–65 meters off Somalia, in 90 meters at Reunion, and in 55 meters at the Caroline Islands. Habitat is rocky or coralline areas.

NAME. The Japanese name 'Boro-kasago' has been used for this species; from 'boro' (ragged or tattered) + 'kasago' (*Sebastiscus marmoratus* or similar species).

Rhinopias aphanes Eschmeyer, new species.
(Figure 8.)

Rhinopias frondosa (not of Günther), WHITLEY, 1964, p. 9, pl. II (3-sentence account reporting a specimen from New Caledonia [this specimen now holotype of *R. aphanes*]).

HOLOTYPE. AMS IB7079 (178 mm. S.L., 235 mm. T.L.), New Caledonia, outside barrier reef facing Nouméa, at a depth of 30 meters, collected by Yves Merlet and Madame R. Catala-Stucki [transferred alive to the Nouméa Aquarium where it lived for less than a week].

Figure 8. *Rhinopias aphanes*, holotype, AMS no. IB7079, 178 mm. S.L., New Caledonia.

Description. (Based on the holotype and only known specimen.) A large-headed, strongly compressed scorpionfish. Dorsal fin with 12 spines and 9½ soft rays; no dorsal spine notably longer than the others, third and fourth spines the longest, eleventh dorsal spine about ⅓ the length of the twelfth spine. Anal fin with 3 spines and 5½ soft rays; third spine slightly longer than second, third extends past second when fin is depressed. Pectoral rays 16, rays 1 or 2 through 6 branched. Gill rakers, including rudiments, total 20, 6 on upper arch, and 14 below, including one at angle; all rakers as short spiny knobs. Scales on body small and cycloid; about 70 vertical scale rows (counting a few scale rows above lateral line from above first lateral line scale to end of hypural plate). Head without scales.

Spination similar to that in other species of *Rhinopias*; see account under the genus. Preorbital bone with two slight lumps over maxillary, obscured by tentacles. Suborbital ridge with 4 spines, first as tiny lump on lateral face of preorbital bone, followed by one below anterior part of orbit and two posterior ones (poorly defined) just before preopercle bone. Nasal spines small. Preocular spine well defined; supraocular spine obscured by tentacle; postocular spine very large and broad. Sphenotic spine as a lump. Supplemental preopercular spine small, obscured by tentacle. First and second preopercular spines longest; third and fourth smaller, fifth almost imperceptible.

Measurements for the holotype in table 1.

Tentacles and skin appendages numerous; most slender; black or striped with black; most branched.

Preserved coloration as in figure 8. Transparent ovoid and round areas

present between the pectoral rays, most prominent as a row near mid-height of pectoral fin. A slide and color photographs taken by Madame Catala-Stucki when the specimen was alive show that the holotype was a beautiful yellow and black. The pallid areas in figure 8 were lemon yellow, with a few traces of white (particularly in one patch on the suborbital stay), and the dark areas in figure 8 were black to dark brown. The skin flaps and tentacles were black bordered by yellow. The transparent areas of the pectoral fin were apparent.

Comparisons and Remarks. Although this specimen was originally identified as *R. frondosa* (Whitley, 1964; Smith, 1966), its color pattern seems distinctive and it is thought to represent a separate species. All of the reported specimens of *R. frondosa* seem to have a fairly consistent color pattern as shown in our figures 5–7, and the figures reported in the synonymy. The holotype of *R. aphanes* is a little larger in size than the holotype and largest known specimen of *R. frondosa*, but it seems unlikely that the color pattern would change this much with growth; there is no indication that the roundish pale areas of *R. frondosa* would become elongate as in *R. aphanes* (see especially the head). The differences in coloration are apparent by comparing figures 5–7 with figure 8. Other differences between *R. frondosa* and *R. aphanes* are as follows: *Rhinopias aphanes* appears to have a smaller orbit, longer snout, a longer jaw, a longer predorsal-fin length, a shorter caudal fin, and some shorter fin spines (table 1); some of these differences may not remain when additional material is found.

Rhinopias aphanes is easily separated from *R. xenops* and *R. argoliba* on the basis of pectoral rays (16 instead of 18) and coloration.

Distribution. This species is known only from the holotype collected near Nouméa, New Caledonia.

Name. The species name is from the Greek word *aphanes* (aph′-å-nēs), a noun, meaning that which is unapparent or inconspicuous, alluding to the camouflage provided by its remarkable coloration and skin flaps.

The common name 'Merlet's scorpionfish' is suggested. Doctor Yves Merlet, an avid diver and underwater naturalist, captured the holotype. Over a 12-year period he made available numerous valuable specimens for display in the Nouméa Aquarium and for study by systematists. He died in a diving accident in 1969.

Related Genera and Species

Other genera and species which appear to be related to, or members of, *Rhinopias* are discussed below. The subfamily name Pteroidichthyinae Fowler is available. Fowler (1938, p. 51, in key) provided the following meager description for the subfamily: "Pterodichthyinae, new subfamily. Dorsal spines 11, anal spines 2 . . . . . *Pteropelor*." The subfamily name is based on the genus *Pteroidichthys* Bleeker. Fowler's incorrect spelling of the subfamily (no i before

the d) was emended by Whitley (1954). In the subfamily description in the key Fowler listed the dorsal spines as 11 and anal spines as 2, but in his description of *Pteropelor*, the only genus he specifically included in the subfamily, he listed dorsal spines as 12 and anal spines as 3. Problems surrounding the dorsal and anal spine counts are discussed below. Whitley (1954, p. 60) is evidently the only subsequent worker to use the subfamily name, and Whitley recognized *Pteropelor* as a synonym of *Rhinopias* and referred *Rhinopias* to the subfamily Pteroidichthyinae. It seems likely that the nominal genera *Rhinopias*, *Pteropelor*, and *Pteroidichthys*, as well as the genera *Pogonoscorpius* Regan and *Hipposcorpaena* Fowler, are closely related. They appear to be derivatives of the subfamily Scorpaeninae, differing mainly in having a more compressed body; but whether they should be retained as a separate subfamily must await a more detailed study.

The monotypic genus *Pogonoscorpius* Regan is here referred to the subfamily Pteroidichthyinae; in fact it may be a synonym of the genus *Rhinopias*. The monotypic genus *Hipposcorpaena* Fowler, based on a juvenile, also seems closely related to *Rhinopias*. The nominal genera *Pteroidichthys* and *Pteropelor* are each known from a single species based on 1 or 2 specimens. *Rhinopias godfreyi* Whitley, also known from a single specimen, seems referable to *Pteroidichthys*. The status of each of these nominal genera and species is discussed below, and some corrections for information given in the original descriptions are made based on examination of the type specimens by the first author.

1. Pogonoscorpius.

Pogonoscorpius REGAN, 1908, p. 236 (type-species *Pogonoscorpius sechellensis* by original designation; monotypic).

Pogonoscorpius sechellensis REGAN, 1908, p. 236, fig. 3 on pl. 28 (original description; type locality Seychelles; holotype BMNH 1908.3.23.172).

Pogonoscorpius seychellensis, SMITH, 1957, pp. 51 and 59, fig. D on pl. 4 (compiled; figure from Regan, 1908; misspelled species).

The genus *Pogonoscorpius* and the species *P. sechellensis* are known only from the holotype of the species. It is clear that Regan intended the species name to be spelled *sechellensis* rather than *seychellensis*, since the same spelling was used both for the description and figure, and Regan also used this same spelling for *Champson sechellensis*, *Synchiropus sechellensis*, and *Scaeops sechellensis*, three other new species described by him in the same work. Smith's spelling (*seychellensis*) is an unjustified emendation.

The holotype agrees with species of the genus *Rhinopias* in meristic features, dentition, spination, and body shape. It differs from them in coloration, distribution of skin flaps (particularly the presence of a median chin barbel), and a less elevated orbit. The drawing accompanying the original description (Regan, 1908, fig. 3 on pl. 28) is poor. We have reproduced a photograph of the holotype

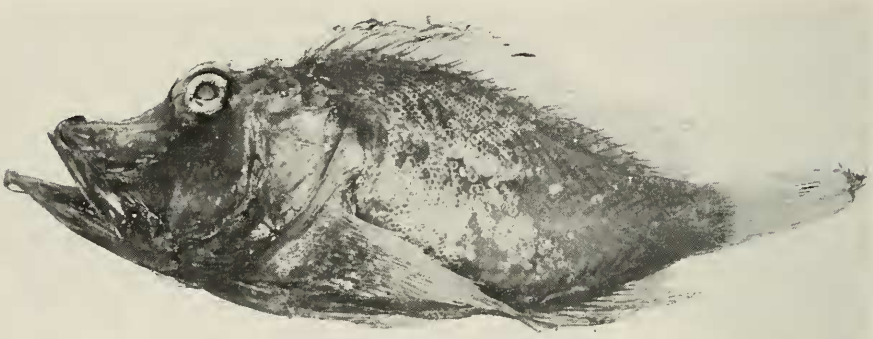

FIGURE 9. *Pogonoscorpius sechellensis*, holotype, BMNH no. 1908.3.23.172, 51.4 mm. S.L., Seychelles.

(fig. 9) which better illustrates the body shape. Additional study when specimens become available may show that this species is best placed in the genus *Rhinopias*.

The following counts for the holotype were recorded: dorsal rays XII + 9½; anal rays III + 5½; pectoral rays 18+18, all rays appear to be unbranched; vertical scale rows estimated at about 60 as given by Regan, many missing; gill rakers difficult to count, 7 on upper arch, 9 (including one at angle) plus additional rudiments on the lower arch. Spination about as in species of the genus *Rhinopias*; supplemental preopercular spine present only on left side, most spines small or low. Some measurements (in mm., percent standard length in parentheses) were recorded as follows: standard length 51.4; total length about 66; head length 23.7 (46); body depth 19.8 (38); orbit diameter 4.5 (09); snout length 10.1 (20); interorbital width 2.2 (04); jaw length 12.1 (24); predorsal-fin length 20.3 (40); caudal fin length 14.4 (28); pectoral fin length 15.9 (31); pelvic fin length 12.3 (24).

Coloration as given by Regan, "yellowish; fins tinged with reddish."

This species appears to be a valid one and is known only from the holotype collected in the Seychelles in 37 fathoms.

2. Hipposcorpaena.

Hipposcorpaena FOWLER, 1938, pp. 71–72 (type-species *Hipposcorpaena filamentosa*, by original designation; monotypic).

Hipposcorpaena filamentosa FOWLER, 1938, pp. 72–73, fig. 31 (original description; type locality Philippine Islands, Gulf of Davao, 7°04′48″N., 125°39′38″E., in 28 fathoms, *Albatross* station D.5253, 18 May 1908; holotype USNM 98819).

The genus *Hipposcorpaena* was based on a single specimen of about 29 mm S.L., USNM 98819. One additional Philippine specimen is available (USNM 168183, *Albatross* station 5174) and is of about the same size as the holotype.

The holotype is now in poor condition. Fowler (1938, p. 73) gives a dorsal fin count of XI + 10, but this should have been XII + 9½; he lists anal rays as 9, but they total 8½ and seem to be III + 5½. Pectoral rays appear to number 14 as given by Fowler. The rays near the lower end of the pectoral fin are the longest, and the fifth from the bottom extends past the posterior base of the anal fin (not as in Fowler's figure 31); the lower principal caudal rays are also the longest. The vertical scale rows were given by Fowler as 30; although many scales are missing, the scale rows probably number about 35–40. *Hipposcorpaena filamentosa* appears to be a valid species known only from the Philippines.

3. Pteroidichthys.

Pteroidichthys Bleeker, 1856, pp. 33–34 (type-species *Pteroidichthys amboinensis* Bleeker by original designation; monotypic); 1876, p. 5 (generic diagnosis).

Pteroidichthys amboinensis Bleeker, 1856, pp. 34–35 (original description; type locality Amboina and Manado, Celebes; two syntypes, RMNH 5873); Günther, 1860, p. 127 (compiled); Bleeker, 1876, pp. 5, 9–10, 12–13, 57–58, fig. 5 on pl. 1 (description compiled from Bleeker, 1856; figure good); 1879, fig. 1 on pl. 414 (figure from Bleeker, 1876); Herre, 1952, p. 436 (compiled from Bleeker); de Beaufort *in* Weber and de Beaufort, 1962, p. 54 (re-examined types; figure redrawn from Bleeker, 1876).

The two syntypes, RMNH 5873, were briefly examined. They are in fairly poor condition and now measure about 67 and 80 mm. in total length and 51 and 57 mm. in standard length. The counts as given by Bleeker and by de Beaufort are dorsal rays XI + 11 and anal rays II + 7. The twelfth element in the dorsal fin does not appear to be segmented, although this is difficult to determine and the ray is long and flexible; counting by the methods used in this paper the dorsal rays number XII + 9½, with the twelfth element very long and at the leading edge of the soft dorsal fin; anal rays II + 6½. For further information see 'Remarks' below.

4. Pteropelor.

Pteropelor Fowler, 1938, p. 77 (type-species *Pteropelor noronhai* Fowler by original designation; monotypic).

Pteropelor noronhai Fowler, 1938, pp. 78–79, fig. 34 (original description; type locality vicinity of Hong Kong, China Sea, 21°33'N., 116°13'E., in 100 fathoms, *Albatross* station D.5310, 4 November 1908; holotype USNM 98892, paratype USNM 99009).

The genus and species were based on two juvenile specimens of 32.7 (USNM 98892) and 35.5 (USNM 99009) mm. in standard length. Fowler (1938, in key, p. 51) states that the dorsal spines number 11 and the anal spines 2, but in the description (pp. 78–79) he reports 12 dorsal spines and 3 anal spines. As with *Pteroidichthys amboinensis* and *Rhinopias godfreyi*, there is difficulty in determining if the twelfth dorsal fin element and the third anal fin element are spines or segmented rays. In *Pteropelor noronhai* these fin rays appear to be unsegmented. The dorsal spine count would be XII + 9½. The paratype has

a total of 8½ anal rays (? III + 5½) and the holotype a total of 9½ (? III + 6½). Fowler states that there are only 5 or 6 lateral line scales anteriorly, but examination of the types shows that the lateral line is probably complete, but many scales have been rubbed off; at least nine tubed scales are present in one specimen. Fowler gives the vertical scale rows as 25 + 2; we estimate that they number considerably more than this, but most scales have been rubbed off. Further information is provided in the 'Remarks' below.

5. Rhinopias godfreyi.

Rhinopias godfreyi Whitley, 1954, pp. 60–61, pl. 3, fig. 2 (original description; type locality Exmouth Gulf, northwestern Australia; holotype AMS IB2977).

This species is known only from the holotype, a specimen 46.1 mm. in standard length. The counts for the specimen are pectoral rays 15, anal rays II + 6½, and the dorsal count is either XI + 10½ or XII + 9½; the twelfth dorsal fin element appears to be unsegmented; the third anal fin element is segmented distally. The vertical scale rows number about 40; the lateral line seems to have been complete, although some scales are rubbed off. (Whitley incorrectly lists the pectoral rays as 14 and anal rays as III + 6; he gave the dorsal ray count as XI + 10.)

Remarks. *Pogonoscorpius* and *Hipposcorpaena* are retained for now as separate monotypic genera which appear to be closely related to the genus *Rhinopias*. On the other hand, *Pteroidichthys amboinensis*, *Pteropelor noronhai*, and *Rhinopias godfreyi* are very closely related species, and *Pteropelor* is considered a synonym of *Pteroidichthys*. (Whitley (1954) went even further and considered *Pteroidichthys* a synonym of *Rhinopias*.) It is possible that more thorough study of the available specimens and additional specimens as they are captured will show that *Pteroidichthys amboinensis* Bleeker 1856, *Pteropelor noronhai* Fowler 1938, and *Rhinopias godfreyi* Whitley 1954 are all based on different sized specimens of the same species, or at least that some of them are synonyms of one another. These specimens are characterized by having dorsal fin rays XII + 9½ (the twelfth element which is at the leading edge of the soft dorsal fin may be segmented in large specimens), anal rays normally II + 6½ (possibly with the third element unsegmented in small specimens); and pectoral rays 14 or 15, rays unbranched (?). They are further characterized by having a very compressed body, very long fins (particularly the anal fin), and long supraocular tentacles which are branched in large specimens. They differ from species of the genera *Rhinopias*, *Pogonoscorpius*, and *Hipposcorpaena* most notably in the condition of the third anal fin element (two rather than three anal spines) and also in such features as a less deep body, shorter head, and lower pectoral ray count. If these three nominal species are all the same species then the localities from which it has been collected are Hong Kong, Celebes,

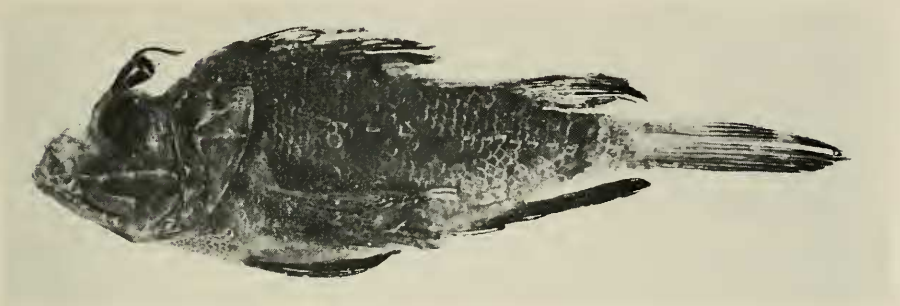

Figure 10. *Pteroidichthys amboinensis*, ZMC uncat., 36.4 mm. S.L., Vietnam.

Amboina, and northwestern Australia. It is an offshore species, probably living in coral in depths from perhaps 30 to 100 fathoms.

One additional specimen (fig. 10) was found which is referable to this complex. The specimen measures 36.4 mm. in standard length and is from the collection of the Zoological Museum of Copenhagen with the following data: collected at Nhatrang Bay, Vietnam, 16 November 1959, by J. Knudsen. This specimen has counts of dorsal rays XII + 9½, anal rays II + 6½, and pectoral rays 16 + 15 (all simple). In coloration it is most like the type of *Pteropelor noronhai*.

Shedding of 'Skin'

Sloughing of 'skin' in the scorpaenid *Taenianotus triacanthus* has been discussed recently by Wickler and Nowak (1969), although they missed an earlier account of shedding in *Taenianotus* by Faulkner (1961). The first mention of shedding was by Gilchrist (1920) for *Agriopus* (subfamily Congiopodinae). Hirosaki (1957) discussed shedding in scorpaenids, including the genera *Pterois, Parapterois*, and *Erosa*, and other fishes, and (1971a–c) in *Rhinopias argoliba*. Faulkner (1961) also reported sloughing of skin in *Pterois sphex*. From museum specimens we can report that this shedding also occurs in stonefishes (*Synanceia*, subfamily Synanceiinae), the genus *Inimicus*, and evidently all species of *Pterois* (subfamily Pteroinae). The holotype of *Rhinopias aphanes* also has pieces of 'skin' hanging from it as do some specimens of *R. xenops* and *R. frondosa*.

Previous authors who have commented on the shed layer have described it as skin, and have correctly pointed out that it is not mucous. Samples have been analysed for us by Richard Krejsa, and he informs us that the shed layer is best termed a cuticle, an epidermal product; some cells are lost with the shed layer but the basic matrix is cuticular. Further histological studies are being made by Dr. Krejsa.

Hirosaki (1971a–c) found that in *R. argoliba* shedding occurred in the Enoshima Aquarium 9 times in 114 days at regular intervals (January 30, Feb-

ruary 13 and 28, March 12 and 30, April 11 and 24, May 8 and 18). The cuticle from the entire body was shed each time. It appears that shedding was a natural event not caused by any sort of shock. The function of the shedding probably involves the removal of algae, external parasites, and other objects which might accumulate on the skin of these basically sedentary fishes.

The genera *Inimicus*, *Minous*, and *Choridactylus* are peculiar scorpaenids which have one to three lower pectoral rays thickened and free. Each free ray is tipped with a 'friction pad' or 'cap.' The caps are easily dislodged in preserved specimens. These thickened caps, covering the distal one-fourth to one-tenth of each ray, are made of the same cuticular substance, although much thicker, as the shed layer of the scorpaenids listed above; almost certainly these caps are used as an aid for 'walking' on the bottom with the free pectoral rays. (These 'caps' will be discussed more fully in a subsequent paper on the subfamily Minoinae.)

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